(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 163 517**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 85303746.3

(51) Int.Cl.⁴: F 16 D 3/84

(22) Date of filing: 29.05.85

(30) Priority: 29.05.84 JP 109237/84

(43) Date of publication of application:
04.12.85 Bulletin 85/49

(84) Designated Contracting States:
DE FR GB

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(54) **Fiber-reinforced dust boot for a mechanical joint.**

(57) A dust boot (3) for a joint (2) is molded from a rubber material containing 2–10% by weight of short fibers. This material is resistant to impregnation by lubricating grease. Therefore, it is possible to make a boot that is lightweight, has a reduced expansion at high speed rotation, and requires less clearance between the boot and adjacent parts.

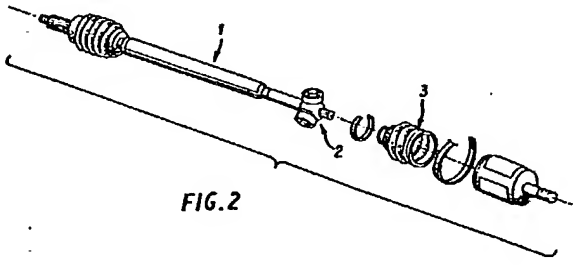

FIG.2

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FIBER-REINFORCED DUST BOOT FOR A MECHANICAL JOINT

BACKGROUND OF THE INVENTION

The present invention relates to an improvement in a dust boot for a mechanical joint such as a constant velocity joint in an automobile or other vehicle. The dust boot serves to protect the joint from dirt and other material from the atmosphere and the road surface. It also prevents the outflow of lubricating grease used in the joint and sealed inside the boot.

Carbon-filled rubber has conventionally been used for manufacturing dust boots. The incorporation of carbon in rubber increases the rigidity of the rubber. However, there is a limit in the extent to which the rigidity of the material used in a boot can be increased because high rigidity causes problems in molding. In addition, a dust boot covering a joint is prone to expand and soften as a result of degradation of the material over time due to absorption of the lubricating grease. Particularly, at high-speed rotation the external diameter of the boot tends to expand due to the centrifugal force acting on it. As a result, it has been necessary in the design of such boots to increase the thickness of the wall in the expanding portions of the boot, and to enlarge the clearance between the boot and the body or other parts of the vehicle.

SUMMARY OF THE INVENTION

The present invention was made to solve the aforementioned problems. An object of the invention is to provide a boot for a joint which can be made very rigid and which has a reduced expansion under high speed rotation and is resistant to impregnation by lubricating grease.

Another object is to secure a design advantage by reducing the clearance needed between the boot and adjacent parts of the vehicle.

Another object is to provide a dust boot which is advantageously lightweight.

The aforementioned objects are attained by molding the boot of the present invention from rubber material containing 2-10 weight percent of short fibers having a length of 2-6 mm. The diameter of the fibers is preferably 30-50 μm.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of an automobile showing drive shafts provided with dust boots;

Fig. 2 is an exploded perspective view of a drive shaft equipped with a boot for a constant velocity joint; and

Fig. 3 is a cross-sectional side elevational view of a boot for a constant velocity joint.

DESCRIPTION OF THE INVENTION

The present boot is molded of rubber material which has been reinforced with short fibers. The rubber material which can be used is not particularly limited. Any synthetic and/or natural rubber may be used.

The fibers suitable for incorporating into the rubber material are synthetic inorganic fibers such as carbon fibers; synthetic organic fibers such as polyester, nylon, or vinylon; and natural fibers such as jute. The fibers may be incorporated into the rubber material by any method provided that the fibers are uniformly distributed therein.

The boot ———————— may be molded by any known conventional molding method, in particular a method using a metal mold.

The shape of the boot ———————————— ————varies depending on the type of joint it protects. For example, the boot may be a straight type or bellows type propeller shaft dust boot, a tierod end boot (for a rack and pinion steering wheel), or a ball joint boot.

A straight type boot made as herein described does not soften upon prolonged contact with lubricating grease, does not become deformed as a result of rotation, and does not expand under high speed rotation. Its durability is also improved because it has a high resistance to abrasion.

In addition to having the same advantages as described for a straight type boot, a bellows type boot made as herein described also saves space in that less clearance is required between the boot and adjacent parts of a vehicle.

A tie rod end boot made as herein described is not subject to problems such as drooping because it is highly rigid. It also presents a design advantage in that less clearance is required.

A ball joint boot made as herein described can be subject to a large angle of torsion without causing the sealing lip of the boot to become separated from the surface of the joint. In addition, this boot is not subject to abrasion due to vertical rocking of the joint.

The boot ——————→ is not limited to the embodiments specifically described.

A preferred embodiment ——————→ is a boot for a constant velocity joint. An example of a boot for a constant velocity joint is described below with reference to the drawings.

Referring to Figs. 1 and 2, an automobile 10 of the front wheel drive type is provided with drive shafts 1,1 for driving the front wheels (WF) of the automobile. A constant-velocity joint 2 is provided in the drive shaft 1. The constant-velocity joint 2 is covered with a boot 3 integrally formed in a bellows shape from a rubber material containing 2 to 10 wt. % of short fibers.

The superior properties of the boot made as herein described are demonstrated by the following comparisons. A boot for a constant velocity joint was made of a rubber material A as herein described —— and was compared to a similar boot made of a conventional material B. Table 1 shows the properties of these two boots.

In Table 1, the volume change (%) is the volume change of the boot material after it has been immersed in lubricating grease at 100°C for 70 hours. This volume change is a measure of the resistance of the boot to impregnation by the grease.

Table 1

	New Material A (Polymer: CR-type short fibers)			Conventional Material B (CR-type polymer
	(I) 2 wt.%	(II) 5 wt.%	(III) 10 wt.%	
Physical properties of material:				
Viscosity ML_{1+4} (100°C)	39	38	41	40
Hardness Hs (°C)	62	66	70	60
Tensile strength (kg/cm^2)	170	165	150	180
Breaking extension (%)	360	340	300	370
Volume change (%)	9.6	8.0	6.5	12
100% modulus (kg/cm^2)	30	34	36	28
50% modulus	16	19	24	12
Workability at the time of mold release	Favorable	Favorable	Slightly difficult	Favorable

Note: **Short fibers are jute provided with adhesion treatment**, in which the fiber surface of jute is covered with isocyanate type adhesive.
"CR" is chloroprene rubber
Breaking extension: Elongation based on a test method of cured rubber JIS K 6301 (Japanese Industrial Standard)

Table 1 shows that the 50% modulus, which is an indicator of rigidity in the region of practical application, increases appreciably in the material which contains a small amount (2 wt. %) of short fibers. At the same time, the viscosity, which is regarded as an indicator of relative ease in moldability, does not increase. Therefore, it is possible to make the boot 3 rigid without impairing its moldability.

Rigidity is enhanced further if the proportion of short fibers is increased. If this proportion exceeds 10 wt. %, however, it becomes difficult to release the boot from a metal mold. Consequently, 10 wt. % is an upper limit in practical application.

If the proportion of short fibers is lower than 2 wt. %, rigidity is not much improved in comparison to a boot in which no short fibers are incorporated. Therefore, any proportion of fibers below 2 wt. % is not suitable.

Furthermore, it is necessary that the fiber segments have a length of no less than 2 mm and no more than 6 mm in order for the dust boot to have a proper rigidity and a proper moldability. It is also preferable that the diameter of the fiber be in the range 30-50 μm.

If the diameter exceeds 50 μm, the fiber reinforced rubber (FRR) shows poor fatigue strength because the short fibers cannot be uniformly dispersed.

If the diameter is less than 30 μm, the fiber reinforcing effect is poor because it is easy for the fiber to cut at the molding.

The volume expansion of a boot is shown by the data of Table 2 in conjunction with

Table 2 shows the volume expansion at points a, b, c, d, e, and f of the boot of the shape shown in Fig. 3 for a boot made of material A as described herein, and for a boot made of a conventional material B. This volume expansion is measured with the boot 3 inclined by θ°, as shown in Fig. 3, that is, by 5° according to the embodiment, in an atmosphere at 70°C and with an engine speed of 1,700 r.p.m.

Table 2

Material \ Measuring point	Expansion (mm) a	b	c	d	e	f
New Material A (I) 2 wt.%	0.8	0.8	1.5	1.5	1.5	1.5
(II) 5 wt.%	0.5	0.5	1.0	1.0	1.0	1.0
(III) 10 wt.%	0.5	0.4	0.8	0.8	0.8	0.8
Conventional Material B	5.0	15.0	14.0	9.0	16.5	13.0

The materials I, II and III in Table 2 contain short natural jute fibers in proportions of 2 wt. %, 5 wt. % and 10 wt. %, respectively.

The resistance of the new material A to impregnation by lubricating grease is high, and as a result, its expansion due to grease absorption is low, as evident from Table 2. Therefore, it is possible to reduce the clearance between the boot and adjacent parts of the vehicle. This is advantageous in the design of space layout in the vicinity of the boot.

Furthermore, since the material A is highly resistant to impregnation by lubricating grease, it is possible to reduce the thickness of the wall of the boot. As a result, the weight of the boot is advantageously reduced.

In summary, by molding a boot from a rubber material containing 2-10 wt. % short fiber segments, it is possible to make a lightweight boot, to check its expansion and thereby gain a design advantage in that less clearance is needed between the boot and adjacent parts of a vehicle.

CLAIMS

1. A dust boot for a joint in a vehicle, characterised in that the boot (3) is molded of a rubber material comprising 2-10 % by weight of short fiber segments having a length of 2-6 mm, said fiber being selected from the group consisting of synthetic inorganic fibers, synthetic organic fibers, and naturally occurring fibers.

2. A dust boot as in claim 1 wherein the fiber has a diameter of 30-50 µm.

3. A dust boot as in claim 1, wherein said boot is a bellows-shaped boot for a constant velocity joint (2).

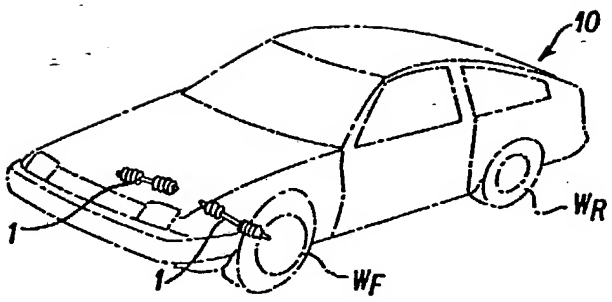

FIG. 1

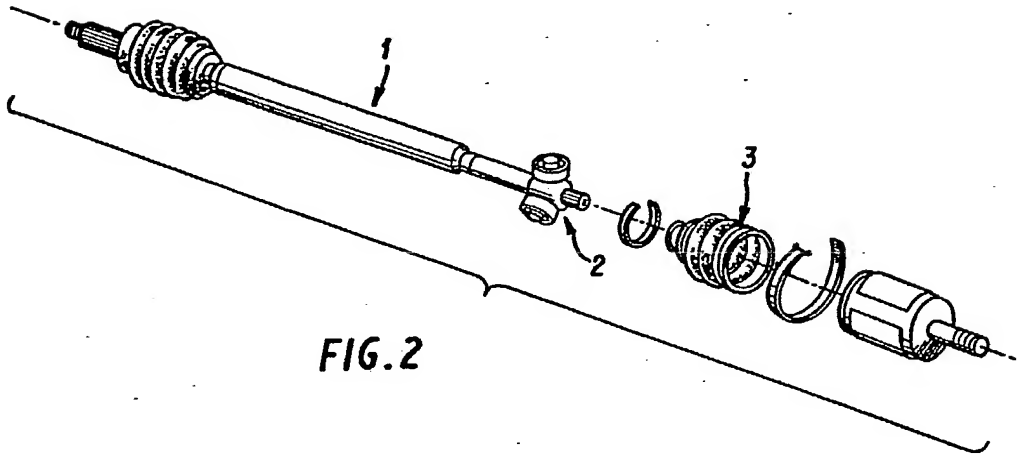

FIG.2

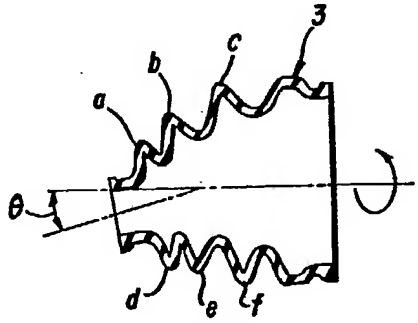

FIG.3

0163517
Application number

European Patent Office

EUROPEAN SEARCH REPORT

EP 85 30 3746

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	US-A-2 755 643 (WILDHABER) * Column 4, lines 3-9; figure 4 *	1,3	F 16 D 3/84
Y	US-A-2 857 189 (JEFFERY) * Column 1, lines 29-37; claims 1-3 *	1	
A		2	
A	DE-A-2 904 521 (CONTINENTAL) * Page 6; figure *	1	
A	EP-A-0 061 320 (GATES)		TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	FR-A-1 160 498 (LUBREPA)		F 16 D F 16 J B 29 H
A	FR-A-2 308 019 (TAURUS)		
A	US-A-1 922 431 (GEYER)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10-07-1985	ORTHLIEB CH.E.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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